Brüel & Kjær

2650

Precision Conditioning Amplifier

Valid from serial no. 976066

037—0211

Service

PROPERTY OF DEPT. CI:
METROLOGY LAB:
DO NOT REMOVE
FROM AREA
a/84

2650
Precision Conditioning Amplifier

Valid from serial no. 976066

037—0211

Consisting of:

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Removal of Module Panel

The bottom panel of the instrument is removed by releasing the large finger screw at the bottom of the front panel. Quarter to a half a turn should be adequate to release the catch. The panel is then removed by sliding it towards the rear of the unit.

Top and side plates of the instrument can each be released by unscrewing the fixed screws on the rear of the unit. These plates are also removed by sliding them backwards.

Trouble Shooting

If any problem should occur with this instrument, then check the DC working voltages from the power supply. Then use the block diagram in order to localize the trouble to be located in one specific circuit.

When a fault has been found and corrected, the voltages and adjustments which are influenced by the correction must be rechecked, and the instrument controlled to see if all basic functions are fulfilled.

The tolerances stated in the instructions can only be used as a guide for adjustment and control.

Any deviations must not be corrected without being sure that the tolerances of the instrument used for making the adjustment are so small as to have no influence on the measurement.

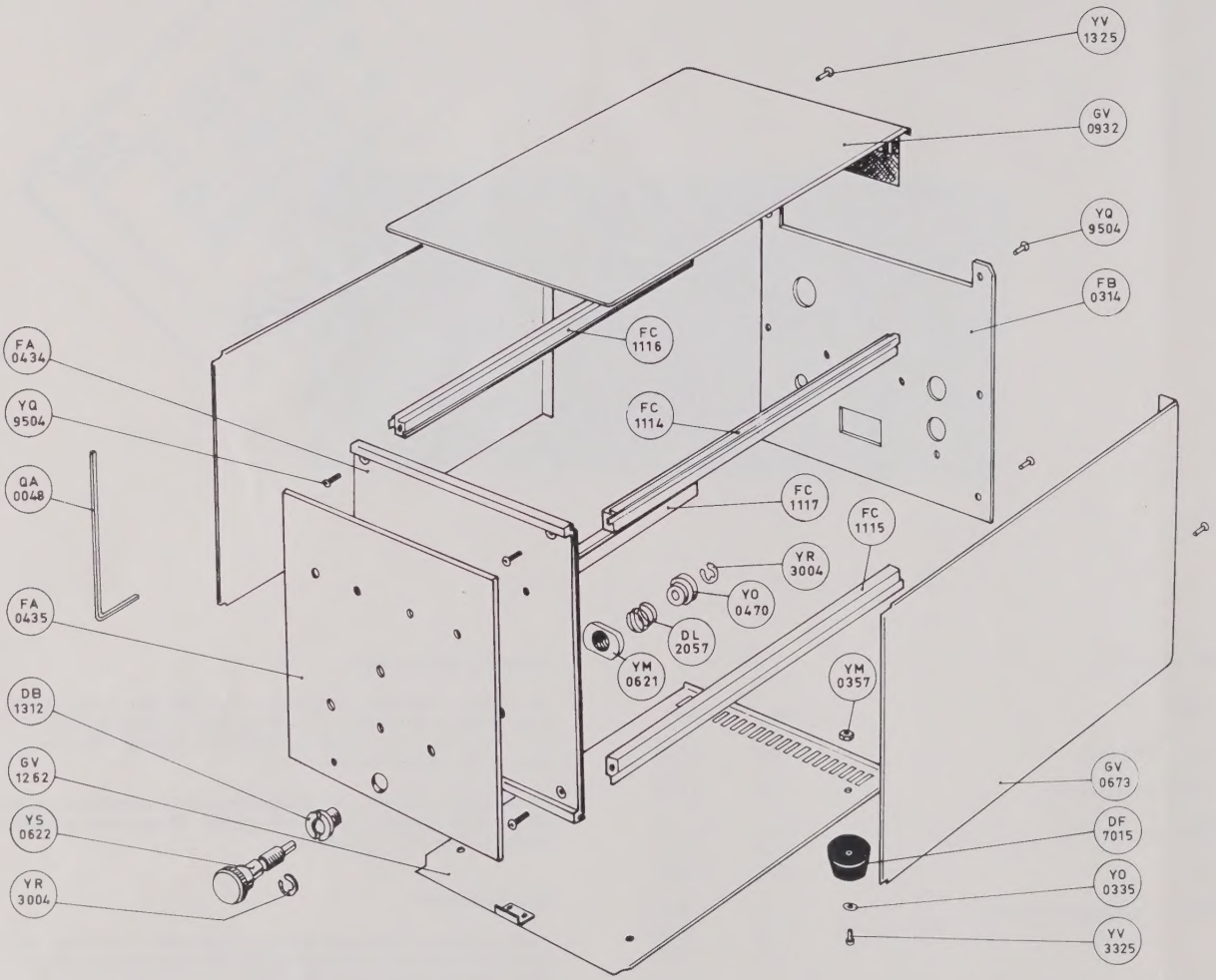
The instructions in this manual are given purely as a guide of equipment. Some faults e.g. small deviations in tolerances, require special control equipment and extensive experience to correct. For these cases the instrument must be sent to the factory.

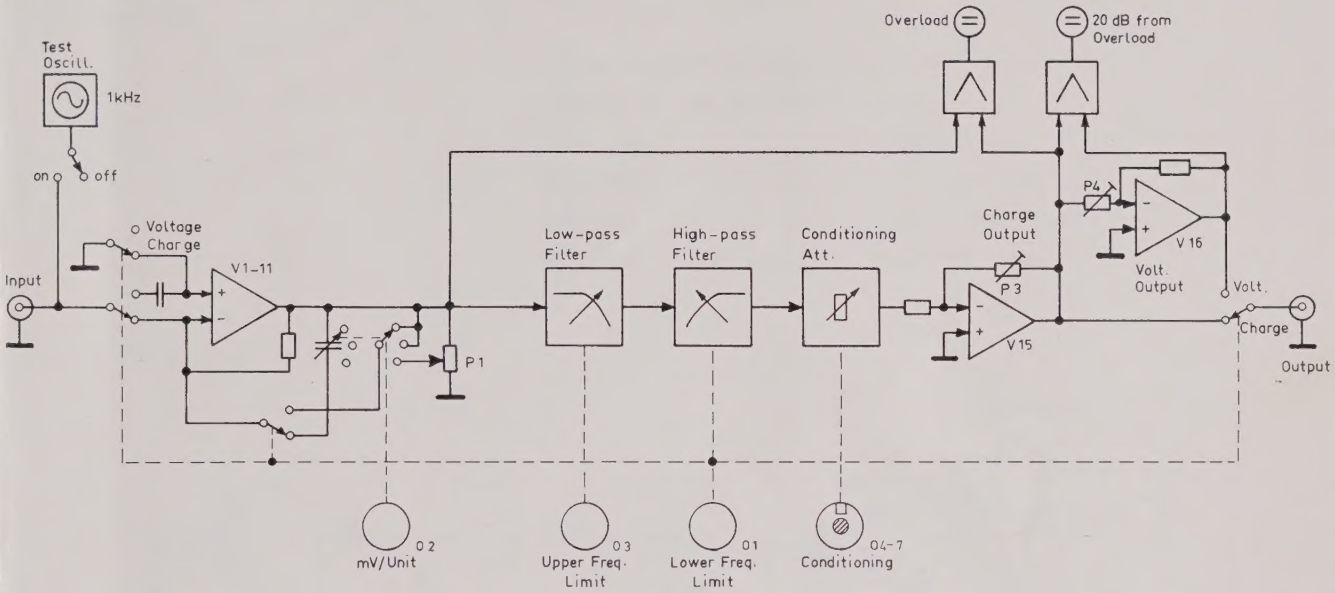
Spare parts

Please state type and serial number of apparatus when spare parts are ordered.

ATTENTION

The opening of the apparatus is likely to expose live parts. Any adjustment, maintenance or repair of the opened apparatus under voltage shall be carried out only by a skilled person who is aware of the hazards involved.


YV 1325
GV 0932
YQ 9504
FB 0314
FC 1116
FC 1114
FC 1117
FC 1115
YR 3004
YO 0470
DL 2057
YM 0621
YM 0357
FA 0434
YQ 9504
QA 0048
FA 0435
DB 1312
GV 1262
YS 0622
YR 3004
GV 0673
DF 7015
YO 0335
YV 3325



The input amplifier consists of V 1 to V 11 and has a positive and a negative input. When the instrument is used in "Charge" mode the positive input is connected to ground through LOWER FREQ. LIMIT switch. The signal input is then the negative input of the amplifier. The feedback path in this mode is capacitive for frequencies above the frequency chosen by LOWER FREQ. LIMIT.

When the instrument is used in "Voltage" mode, the positive input of the amplifier is used as the signal input. The feedback components in this mode are resitive selected by VOLT/UNIT.

From the input amplifier the signal is fed to a low-pass filter, and immediately after this to a high-pass filter. Both filters have the cut-off frequency (—3 dB point) corresponding to the switch position, and a roll-off slope of 12 dB/oct.

The output from the high-pass filter is via the conditioning attenuator fed to the output amplifier. The output amplifier consists of two identical integrated amplifiers V15 and V16. The output from V15 is used when the instrument is switched to "Charge" mode and the output from V16 is used when the instrument is switched to "Voltage" mode.

The reason to split up the output amplifier is the claim to have a possibility to make an adjustment of the amplification when 2650 is used in "Voltage" mode. Furthermore V 16 turn the phase which means that the output signal is in phase with the input signal.

The level detector consists of two trigger circuits, one for positive and negative overload, and one which indicates that the signal level is 20 dB from overload.

Furthermore the instrument consists of a 1 kHz test oscillator. The oscillator is connected to the input through a 1 nF capacitor when INT. TEST SOURCE is positioned in "On". The output from the oscillator is factory adjusted to give 2 Vpp which is equal to 1 pC/mV. The output from the amplifier will then be 2 Vpp or 0,7 V RMS when VOLT/UNIT is positioned in "0,01" and TRANSDUCER SENS. in "10—0—0—0".

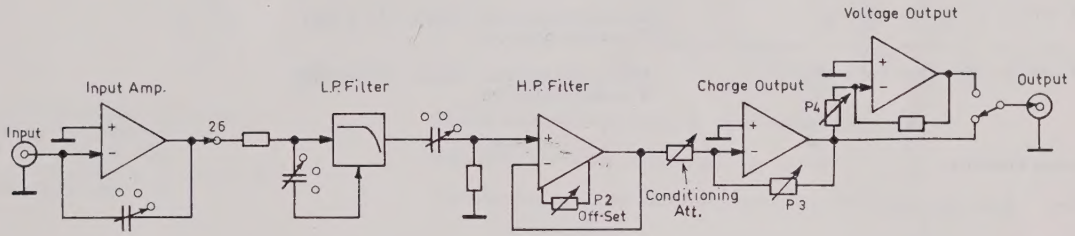
2.1. Power Supply

Voltages valid for 2650 connected to a mains voltage of 220 V:

All voltages are measured with respect to ground.

AC Voltages:	DC Voltages:
pin 6: 47 V.	pin 1: 14,5 – 16 V.
pin 7: 47 V.	pin 2: —14,0 – —15,7 V.
Between pin 11 and 12: 250 V.	pin 9: 98 – 110 V.

2.2. DC Balance



a. Input Amplifier.

TRANSDUCER SENS.: "10—0—0—0" VOLT/UNIT: "0,001 (1—11 pC, mV/g)" LOWER FREQ. LIMIT: "3 Hz/Charge" UPPER FREQ. LIMIT: "Lin." TEST SOURCE: "Off"	DC voltage on terminal 26: max. 100 mV
VOLT/UNIT to "0,1 (1—11 pC, mV/g)"	DC voltage on terminal 26: max. 100 mV

b. Output Amplifier.

TRANSDUCER SENS.: "1—0—0—0" VOLT/UNIT: "0,01 (1—11 pC, mV/g)" LOWER FREQ. LIMIT: "3 Hz/Charge" UPPER FREQ. LIMIT: "Lin." TEST SOURCE: "Off"	DC voltage on "Output" : 0 V ± 1 mV If necessary adjust P 2
LOWER FREQ. LIMIT to "3 Hz/Voltage"	DC voltage on "Output" : 0 V ± 7 mV
LOWER FREQ. LIMIT to "2 kHz/Charge"	DC voltage on "Output" : 0 V ± 20 mV
LOWER FREQ. LIMIT to "3 Hz/Charge" CONDITIONING Att. to "10—0—0—0"	DC voltage on "Output" : 0 V ± 10 mV

2.3. Test Oscillator

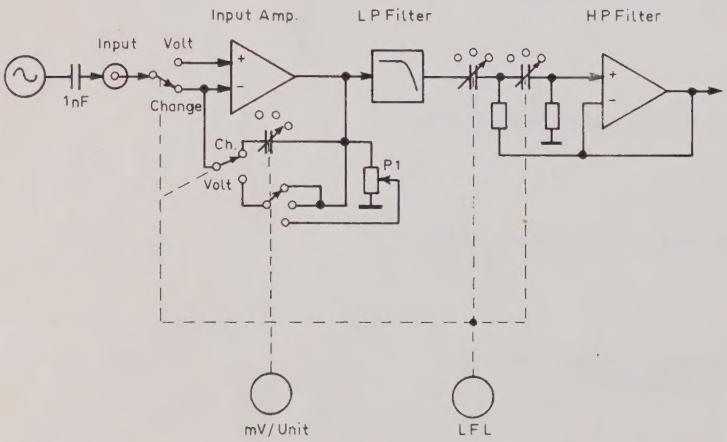
TRANSDUCER SENS.: "10—0—0—0" VOLT/UNIT: "0,01 (1—11 pC, mV/g)" LOWER FREQ. LIMIT: "0,3 Hz/Charge" UPPER FREQ. LIMIT: "Lin." INT. TEST SOURCE: "On"	Measure the oscillator voltage on terminal 6: 0,71 V RMS If necessary adjust P6.

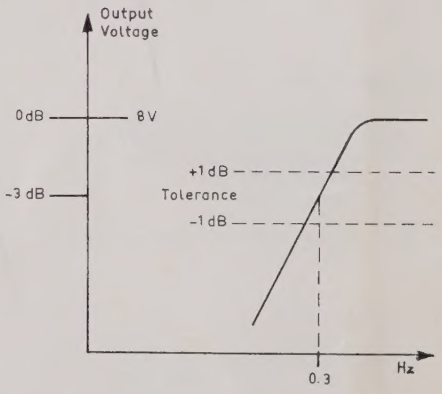
2.4. Sensitivity

TRANSDUCER SENS.: "10—0—0—0" VOLT/UNIT: "0,01 (1—11 pC, mV/g)" LOWER FREQ. LIMIT: "0,3 Hz/Charge" UPPER FREQ. LIMIT: "Lin." INT. TEST SOURCE: "On"	Measure the signal on "Output": 0,71 V RMS If necessary adjust P3.
VOLT/UNIT to "0,1 (1—11 pC, mV/g)"	Measure the signal on "Output": 7,1 V RMS If necessary adjust C12.
VOLT/UNIT to "0,01 (1—11 pC, mV/g)" LOWER FREQ. LIMIT to "0,3 Hz/Voltage"	Measure the signal on "Output": 0,71 V RMS If necessary adjust P4.
VOLT/UNIT to "0,1 (1—11 pC, mV/g)"	Measure the signal on "Output": 7,1 V RMS If necessary adjust P1.
VOLT/UNIT to "0,001 (1—11 pC, mV/g)"	Measure the signal on "Output": 71 mV RMS If necessary adjust P5.

2.5. Frequency Response

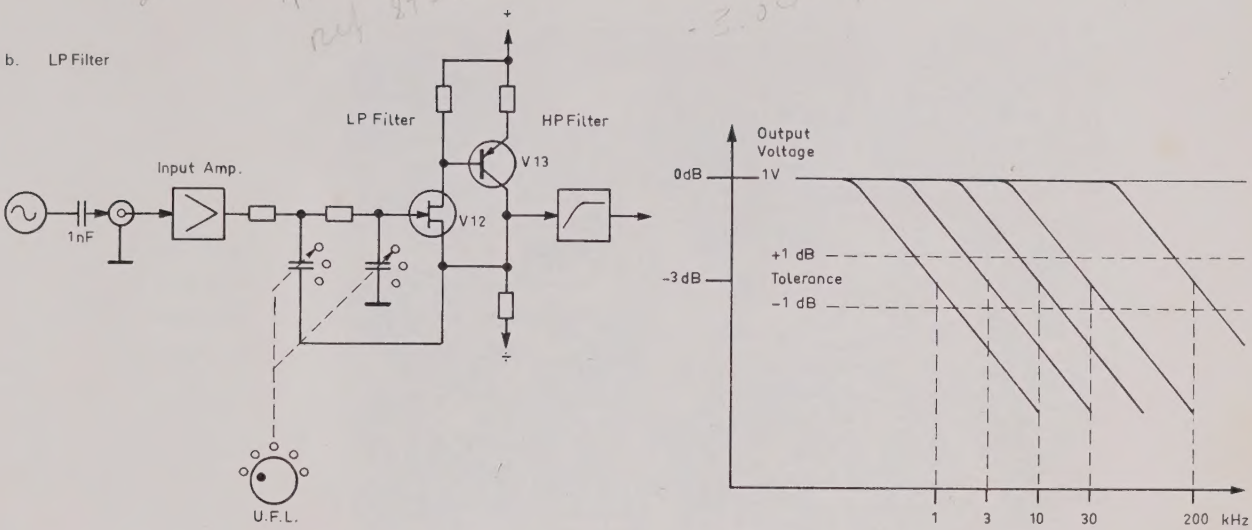
a. HP Filter





TRANSDUCER SENS.: "10—0—0—0" UPPER FREQ. LIMIT: "Lin." INT. TEST SOURCE: "Off" LOWER FREQ. LIMIT: "0,3/Charge" VOLT/UNIT: "0,001 (1—11 pC, mV/g)"	Connect a Sine Wave Generator to "Input" through a 1 nF capacitor. Adjust the input voltage (at 1 kHz) for 1 V on "Output". Check the output voltage at 0,3 Hz: —3 dB ± 1 dB.
VOLT/UNIT to "0,01 (1—11 pC, mV/g)"	Decrease the input signal 20 dB. Check the frequency cut-off: —3 dB ± 1 dB.
VOLT/UNIT to "0,1 (1—11 pC, mV/g)"	Decrease the input signal 20 dB. Check the frequency cut-off: —3 dB ± 1 dB.
VOLT/UNIT to "0,01 (1—11 pC, mV/g)" LOWER FREQ. LIMIT to "0,3/Volt"	Adjust the input frequency for an output voltage of —3 dB Check the input frequency to be within 0,15 — 0,25 Hz.

b. LP Filter



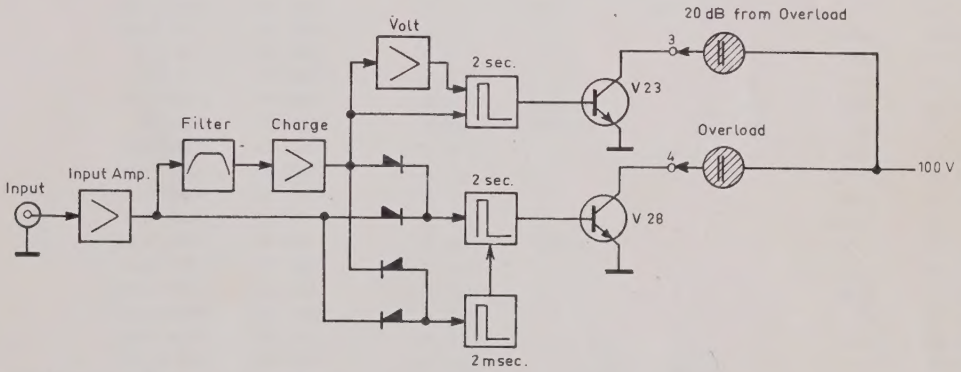
TRANSDUCER SENS.: "10—0—0—0"
LOWER FREQ. LIMIT: "0,3/Charge"
INT. TEST SOURCE: "Off"
VOLT/UNIT: "0,01 (1—11 pC, mV/g)"
UPPER FREQ. LIMIT: "Lin."

Connect a Sine Wave Generator to "Input" through a 1 nF capacitor.

Adjust the input voltage (at 1 kHz) to 1 V on "Output".

Check the frequency response for all positions of UPPER FREQ. LIMIT switch.

2.6. Overload Indicator



TRANSDUCER SENS.: "10—0—0—0"
UPPER FREQ. LIMIT: "Lin."
INT. TEST SOURCE: "Off"
LOWER FREQ. LIMIT: "0,3/Voltage"
VOLT/UNIT: "0,01 (1—11 pC, mV/g)"

Connect a Sine Wave generator to "Input" and an oscilloscope to "Output"

Increase the input voltage (at 1 kHz) and check that the indicator lamp "20 dB from Overload" lights up when the output voltage reachs 2 Vpp.

Increase the input voltage 20 dB and check that the indicator lamp "Overload" lights up

Check that the output voltage has not yet been limited.

2.7. Noise

TRANSDUCER SENS.: "1—0—0—0"
UPPER FREQ. LIMIT: "Lin."
LOWER FREQ. LIMIT: "0,3 Hz/Voltage"
INT. TEST SOURCE: "Off"
VOLT/UNIT: "0,1 (1—11 pC, mV/g)"

The instrument should be mounted with side- top- and bottom-plates.

Connect "Input" to ground though a capacitor of 1 nF. Solder the capacitor in a standard plug JP 0028 to prevent pick-up noise.

Connect an Electronic Voltmeter to "Output" and measure the noise signal: max. 1 mV (band width 2—200 000 Hz).

Remove JP 0028 and screw on the screening cap YM 0420.

LOWER FREQ. LIMIT to "0,3/Charge"

Max. noise signal on "Output": 100 µV (bandwidth 2—20 000 Hz).

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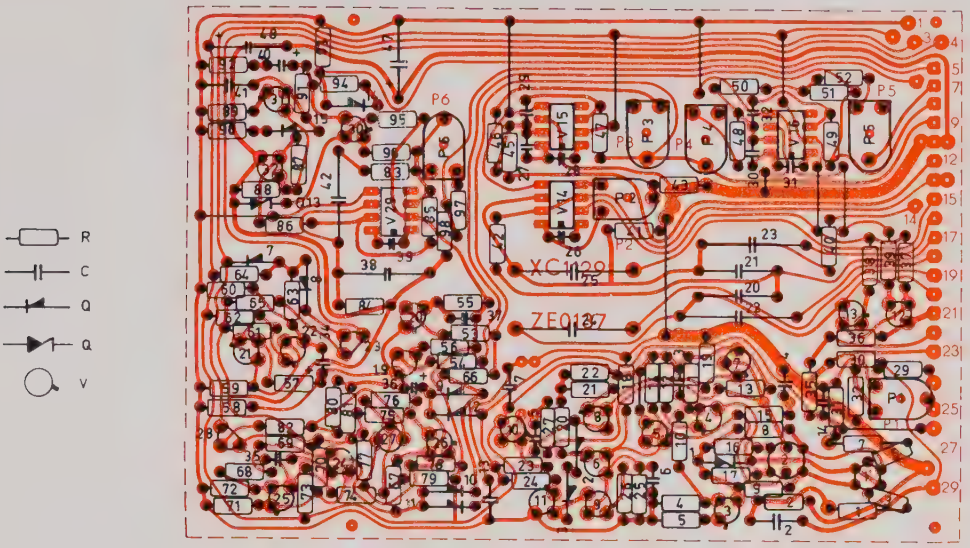


Viewed from the printed circuit side

C 2	Polyester		10 nF/250 V	CS 0394
C 3	Ceramic		1 nF/400 V	CK 3101
C 4	-		390 pF/400 V	CK 2391
C 5	-		60 pF/400 V	CK 1600
C 6	-		82 pF/63 V	CK 1820
C 7,13	-		47 nF/30 V	CK 4470
C 14	-		33 pF/400 V	CK 3003
C 20,21	Polystyrene		4 nF/30 V	CT 1536
C 22,23	Polycarbonate		390 nF/100 V	CS 0341
C 24,25	-		6,8 µF/63 V	CS 0397
C 26	Ceramic		30 pF/400 V	CK 0105
C 27	-		150 pF/400 V	CK 2151
C 28	-		3,3 pF/250 V	CK 0331
C 29	-		10 pF/400 V	CK 1100
C 30	-		150 pF/400 V	CK 2151
C 31	-		10 pF/400 V	CK 1100
C 32	-		18 pF/400 V	CK 1180
C 34	Tantalum		2,2 µF/35 V	CF 0022
C 35	Ceramic		220 pF/400 V	CK 2222
C 36	Tantalum		2,2 µF/35 V	CF 0022
C 37	Ceramic		220 pF/400 V	CK 2222
C 38	Polystyrene		16 nF/63 V	CT 1539
C 39	Ceramic		33 pF/400 V	CK 3003
C 40	Tantalum		3,3 µF/16 V	CF 0014
C 41	Polycarbonate		100 nF/100 V	CS 0409
C 42	Polystyrene		16 nF/63 V	CT 1539
C 47,48	Electrolytic		10 µF/25 V	CE 0416

P 1	Trimmer	Cermet	lin	220 Ω	PG 1221
P 2	-	Carbon	-	2 MΩ	PG 5202
P 3,4	-	Cermet	-	470 Ω	PG 1504
P 5	-	-	-	220 Ω	PG 1221
P 6	-	-	-	470 Ω	PG 1504

Q 1	Ze.	ZF 4,3	4,0-4,6 V/0,25 W	QV 1110
Q 2,3	Si.	BAX 16	150 V/300 mA	QV 0217
Q 7-12	-	BAX 16	150 V/300 mA	QV 0217
Q 13	Ze.	ZG 6,8	6,0-7,5 /0,25 W	QV 1106
Q 14,15	Si.	BAX 16	150 V/300 mA	QV 0217

R 1	Carbon	1/4 W	10%	1,8 GΩ	RH 0019
R 2	-	1/8 W	-	10 MΩ	RB 7100
R 3	Metal	1/4 W	1%	1,5 kΩ	RF 3150
R 4	-	-	-	8,25 kΩ	RF 3825
R 5	-	-	-	1,74 kΩ	RF 3174
R 6	-	-	-	1,5 kΩ	RF 3150
R 7	Carbon	-	20%	5,6 GΩ	RH 0920
R 8,9	Metal	-	1%	3,01 kΩ	RF 3301
R 10	-	-	-	100 kΩ	RF 5100
R 11	-	-	-	6,04 kΩ	RF 3604
R 12	-	-	-	1,74 kΩ	RF 3174
R 13,14	-	-	-	21,5 kΩ	RF 4215
R 15	Carbon	-	5%	270 Ω	RB 2270
R 16,17	-	-	-	22 Ω	RB 1220
R 18,19	-	-	-	56 kΩ	RB 4560
R 20,21	-	-	-	33 Ω	RB 1330
R 22	-	-	-	2,2 kΩ	RB 3220
R 23,24	-	-	-	12 Ω	RB 1120
R 25,26	-	-	-	2,7 kΩ	RB 3270
R 27	-	-	-	560 Ω	RB 2560
R 29	-	-	-	470 Ω	RB 2470
R 30	-	-	-	18 kΩ	RB 4180
R 31	Metal	-	1%	9,09 kΩ	RF 3909
R 32	-	-	-	909 Ω	RF 2909
R 35,36	-	-	-	37,4 kΩ	RF 4374
R 37	Carbon	-	5%	3,9 kΩ	RB 3390
R 38	-	-	-	100 Ω	RB 2100
R 39	Metal	-	1%	11 kΩ	RF 4110
R 40	-	-	-	33,2 kΩ	RF 4332
R 41	-	-	-	196 kΩ	RF 5196
R 42	-	-	-	100 kΩ	RF 5100
R 43	Carbon	1/8 W	10%	3,3 MΩ	RB 6330
R 45	Metal	1/4 W	1%	1 kΩ	RF 0296
R 46	-	-	-	10,0 kΩ	RF 4100
R 47	Carbon	-	5%	100 Ω	RB 2100
R 48	Metal	-	1%	10,0 kΩ	RF 4100
R 49	Carbon	-	5%	100 Ω	RB 2100
R 50	Metal	-	1%	698 Ω	RF 2698
R 51	-	-	-	9,31 kΩ	RF 3931
R 52	-	-	-	200 Ω	RF 2200
R 53,54	Carbon	-	5%	33 kΩ	RB 4330
R 55,56	-	-	-	47 kΩ	RB 4470

continued

ZE 0137

PARTS LIST

R 57	Carbon	1/4 W	5%	10 kΩ	RB 4100
R 58	-	-	-	1 MΩ	RB 6100
R 59	-	-	-	100 kΩ	RB 5100
R 60	Metal	-	1%	59 kΩ	RF 4590
R 61	-	-	-	1,3 kΩ	RF 3130
R 62	-	-	-	14 kΩ	RF 4140
R 63	-	-	-	36,5 kΩ	RF 4365
R 64	Carbon	-	5%	150 kΩ	RB 5150
R 65	-	-	-	2,2 kΩ	RB 3220
R 66	-	-	-	4,7 kΩ	RB 3470
R 67	-	-	-	2,2 MΩ	RB 6220
R 68,69	-	-	-	100 kΩ	RB 5100
R 70	Metal	-	1%	6,49 kΩ	RF 3649
R 71	-	-	-	2,67 kΩ	RF 3267
R 72	Carbon	-	5%	390 kΩ	RB 5390
R 73	-	-	-	100 kΩ	RB 5100
R 74	-	-	-	330 kΩ	RB 5330
R 75,76	-	-	-	100 kΩ	RB 5100
R 77	Metal	-	1%	6,49 kΩ	RF 3649
R 78	-	-	-	2,67 kΩ	RF 3267
R 79	Carbon	-	5%	390 kΩ	RB 5390
R 80	-	-	-	27 kΩ	RB 4270
R 81	-	-	-	33 kΩ	RB 4330
R 82	-	-	-	150 kΩ	RB 5150
R 83,84	Metal	-	1%	10,0 kΩ	RF 4100
R 85	-	-	-	4,42 kΩ	RF 3442
R 86	Carbon	-	5%	1,5 kΩ	RB 3150
R 87,88	-	-	-	100 kΩ	RB 5100
R 89	-	-	-	10 kΩ	RB 4100
R 90	-	-	-	150 kΩ	RB 5150
R 91	-	-	-	10 kΩ	RB 4100
R 92	-	-	-	1 kΩ	RB 3100
R 93	-	-	-	100 kΩ	RB 5100
R 94	-	-	-	820 kΩ	RB 5820
R 95	-	-	-	5,6 kΩ	RB 3560
R 96	-	-	-	4,7 kΩ	RB 3470
R 97	-	-	-	1,2 kΩ	RB 3120
R 98	-	-	-	220 Ω	RB 2220

V 1	FET	N	AD009	VB 1048
V 2	Silicon	NPN	TD101	VB 5300
V 3	-	-	BC107	VB 0032
V 4	-	PNP	BC177	VB 0071
V 5	-	NPN	BC107	VB 0032
V 6	-	PNP	BC177	VB 0071
V 7	-	NPN	BC107	VB 0032
V 8	-	PNP	BC177	VB 0071
V 9,10	-	NPN	BC107	VB 0032
V 11	-	PNP	BC177	VB 0071
V 12	FET	N	E102	VB 1028
V 13	Silicon	PNP	BC177	VB 0071
V 14	OP.Ampl.		TL071	VE 0141
V 15,16	- -		LM301AN	VE 0017
V 19,20	Silicon	NPN	BC107	VB 0032
V 21,22	-	PNP	BC177	VB 0071
V 23	-	NPN	BSS38	VB 0549
V 24,25	-	-	BC107	VB 0032
V 26,27	-	PNP	BC177	VB 0071
V 28	-	NPN	BSS38	VB 0549
V 29	Op.Ampl.		LM301AN	VE 0017
V 30	Silicon	PNP	BC177	VB 0071
V 31	-	NPN	BC107	VB 0032
V 32	FET	N	E102	VB 1052

Printed Circuit Board XC 1129

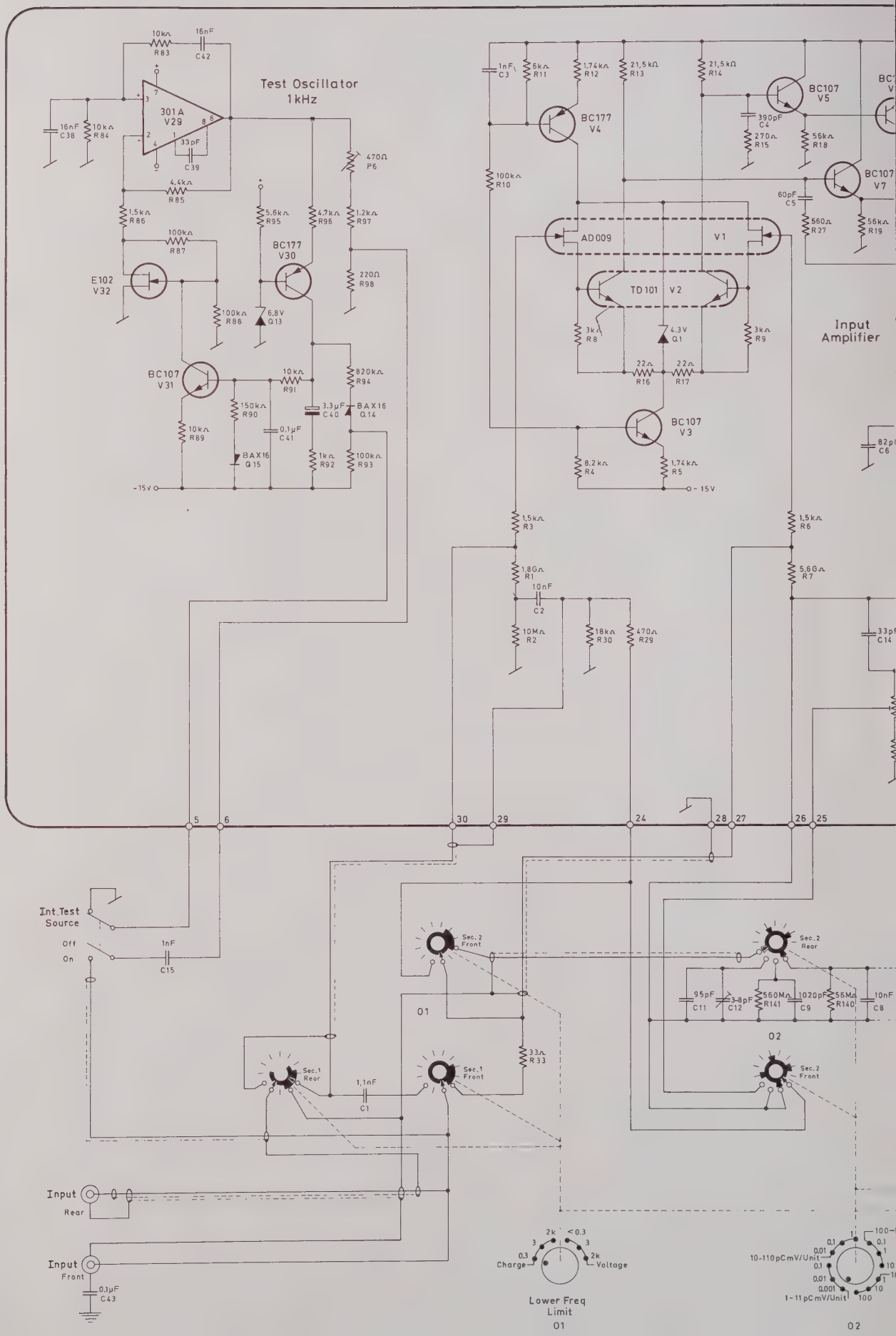
Parts shown on the circuit diagram but not included in ZE 0137.

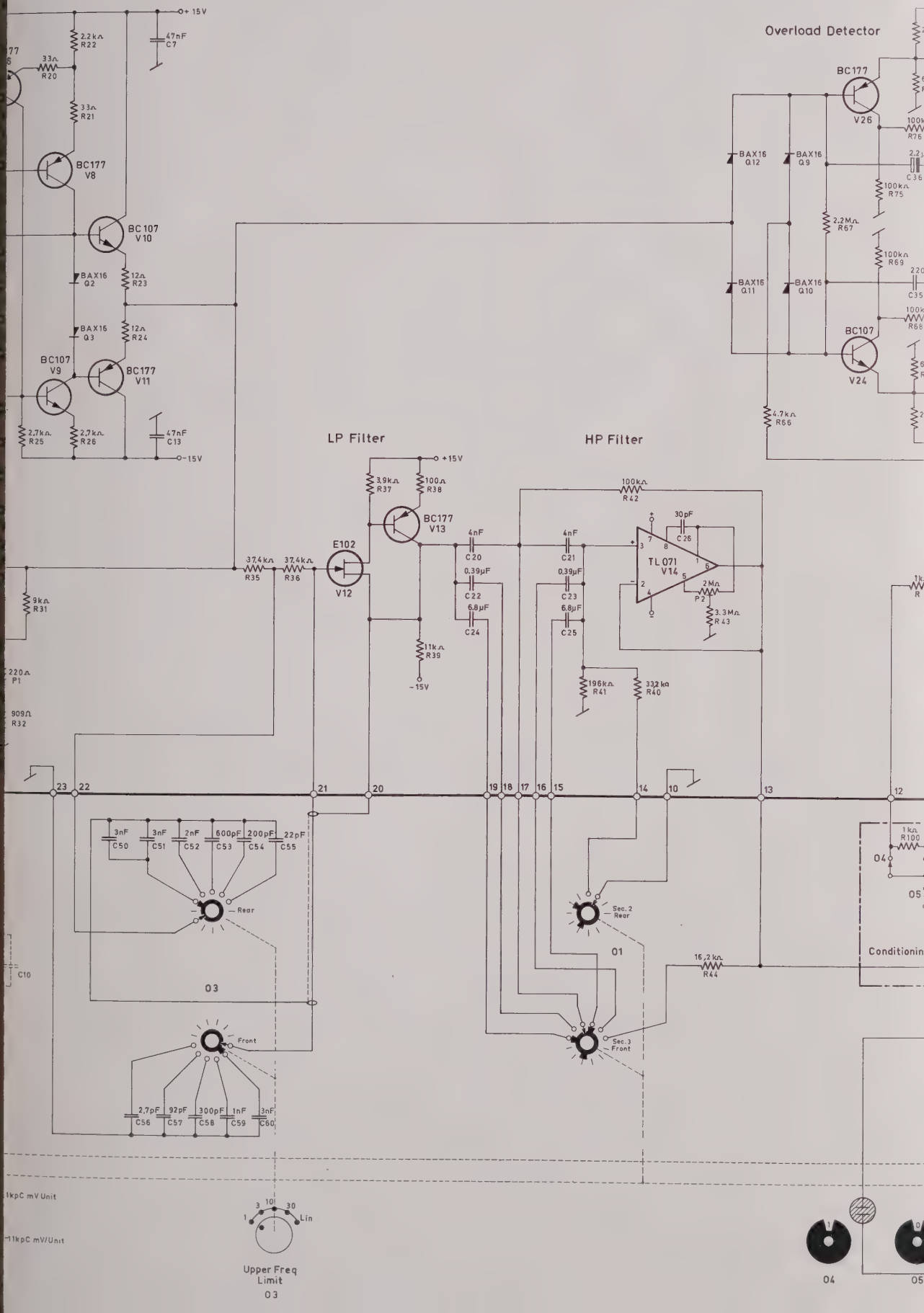
C 1	Polystyrene	1,1 nF/63 V	CT 1148
C 8	Mica	10 nF/50 V	CM 0013
C 9	-	1020 pF/50 V	CM 0014
C 11	-	95 pF/50 V	CM 0015
C 12	Trimmer	3-8 pF/63 V	CV 0027
C 15	Polystyrene	1 nF/63 V	CT 1170
C 43	Polycarbonate	100 nF/100 V	CS 0334
C 50,51	Polystyrene	3 nF/30 V	CT 1157
C 52	-	2 nF/63 V	CT 1123
C 53	-	600 pF/125 V	CT 1109
C 54	-	200 pF/100 V	CT 1118
C 55	Ceramic	22 pF/400 V	CK 1220
C 56	-	2,7 pF/400 V	CK 0270
C 57	Polystyrene	92 pF/63 V	CT 1550
C 58	-	300 pF/100 V	CT 1112
C 59	-	1 nF/63 V	CT 1132
C 60	-	3 nF/30 V	CT 1157

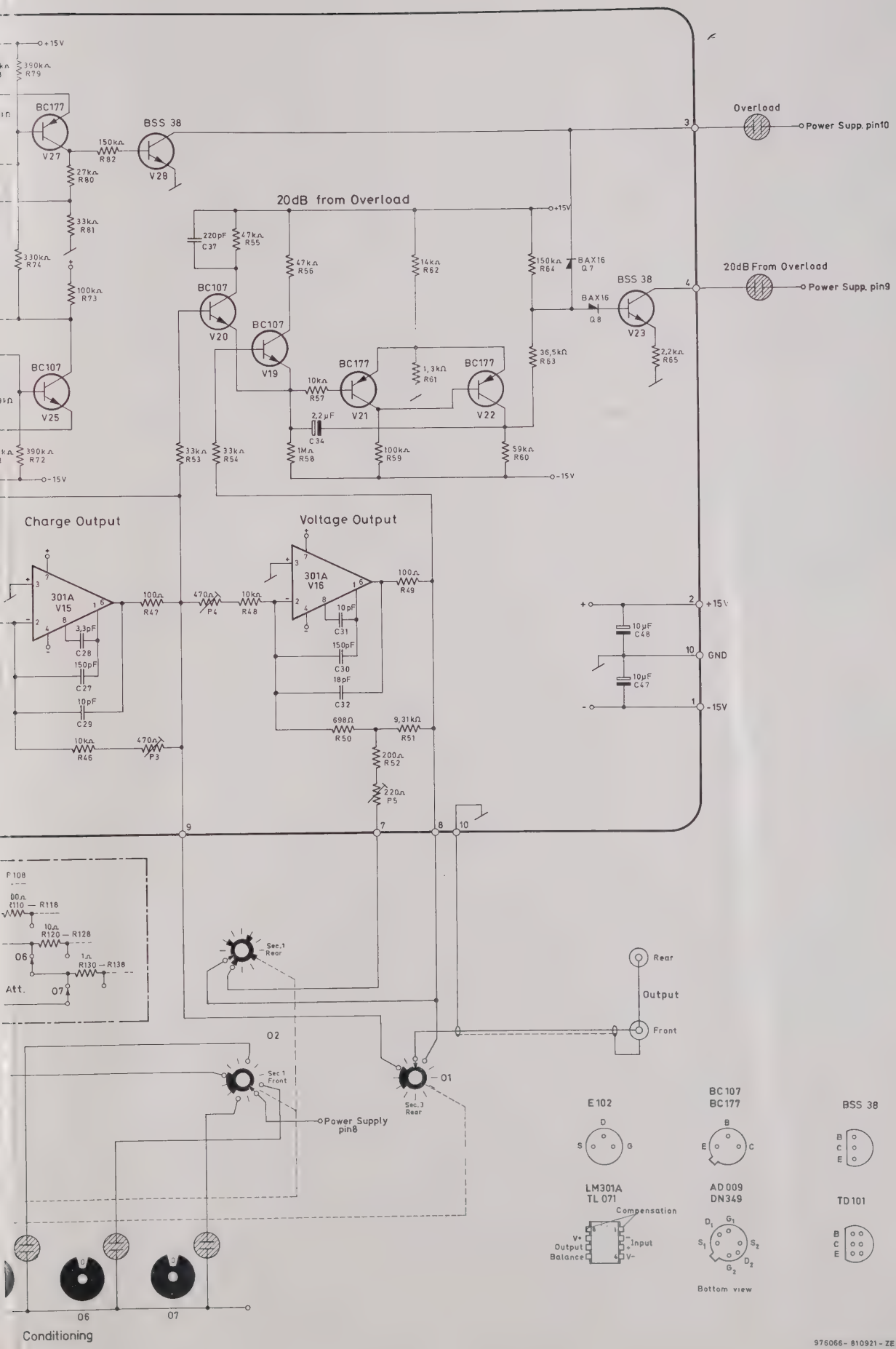
O 1	Selector (Lower Freq.Limit)	OH 3035
	Above with components	OE 0131
O 2	Selector (Volt/Unit)	OH 3036
	Above with components	OE 0132
O 3	Selector (Upper Freq. Limit)	OH 3044
	Above with components	OE 0133
O 4-7	Selector (Transducer Sensitivity)	OI 0018
O 4	With components 1 kΩ	OE 0130
O 5	With components 100 Ω	OE 0129
O 6	With components 10 Ω	OE 0128
O 7	With components 1 Ω	OE 0127
	Mains socket	OA 0037

R 33	Carbon	1/4 W	5%	33 Ω	RB 1330
R 44	-	-	-	16,2 kΩ	RB 4162
R 100-108	Metal	-	1%	1,00 kΩ	RF 0296
R 110-118	-	-	-	100 Ω	RF 0323
R 120-128	-	-	-	10 Ω	RF 1100
R 130-138	Carbon	-	5%	1 Ω	RB 0100
R 140	-	-	10%	56 MΩ	RH 0913
R 141	-	-	20%	560 MΩ	RH 0914

Miniature socket	JJ 0031
Coaxial socket	JJ 0108
BNC socket	JJ 0130
Banana socket	JT 6204
Toggle switch (Int. Test Source)	NN 0047
Sensitivity Dial (0-9)	SD 0019
Sensitivity Dial (0-10)	SD 0020
Knob for above	SN 0039
Knob 20 mm	SN 2021
Neon Lamp	VS 1003


Test Oscillator
1kHz
301A
V29
10kΩ R83
16nF C42
16nF C38
10kΩ R84
33pF C39
4,4kΩ R85
470Ω P6
1,5kΩ R86
100kΩ R87
5,6kΩ R95
4,7kΩ R96
1,2kΩ R97
220Ω R98
BC177 V30
E102 V32
100kΩ R88
6,8V Q13
BC107 V31
10kΩ R91
820kΩ R94
150kΩ R90
3,3µF C40
BAX16 Q14
10kΩ R89
0,1µF C41
BAX16 Q15
1kΩ R92
100kΩ R93
-15V
1nF C3
6kΩ R11
1,74kΩ R12
21,5kΩ R13
21,5kΩ R14
BC107 V5
BC177 V4
390pF C4
270Ω R15
56kΩ R18
100kΩ R10
BC107 V7
60pF C5
560Ω R27
56kΩ R19
AD009
V1
TD101
V2
3kΩ R8
4,3V Q1
3kΩ R9
Input Amplifier
22Ω R16
22Ω R17
BC107 V3
8,2kΩ R4
1,74kΩ R5
-15V
82p C6
1,5kΩ R3
1,8GΩ R1
10nF C2
10MΩ R2
18kΩ R30
470Ω R29
1,5kΩ R6
5,6GΩ R7
33p C14
5
6
30
29
24
28
27
26
25
Int. Test Source
Off
On
1nF C15
Sec.2 Front
Sec.2 Rear
95pF C11
3-8pF C12
560MΩ R141
1020pF C9
56MΩ R140
10nF C8
01
02
33Ω R33
Sec.1 Rear
1,1nF C1
Sec.1 Front
Sec.2 Front
Input Rear
Input Front
0,1µF C43
2k
<0.3
3
3
0.3
2k
Charge
Voltage
Lower Freq Limit
01
10-110pCmV/Unit
1-11pCmV/Unit
02


Overload Detector
LP Filter
HP Filter
+15V
-15V
47nF C7
2.2kΩ R22
33Ω R20
33Ω R21
BC177 V8
BC 107 V10
BAX16 Q2
12Ω R23
BAX16 Q3
12Ω R24
BC107 V9
BC177 V11
2,7kΩ R25
2,7kΩ R26
47nF C13
BC177 V26
BAX16 Q12
BAX16 Q9
BAX16 Q11
BAX16 Q10
100kΩ R76
100kΩ R75
2,2MΩ R67
100kΩ R69
BC107 V24
4,7kΩ R66
3,9kΩ R37
100Ω R38
BC177 V13
E102 V12
37,4kΩ R35
37,4kΩ R36
4nF C20
0,39µF C22
6,8µF C24
11kΩ R39
100kΩ R42
4nF C21
0,39µF C23
6,8µF C25
30pF C26
TL 071 V14
2MΩ P2
3,3MΩ R43
196kΩ R41
332kΩ R40
9kΩ R31
220Ω P1
909Ω R32
3nF C50
3nF C51
2nF C52
600pF C53
200pF C54
22pF C55
Rear
03
C10
Front
2,7pF C56
92pF C57
300pF C58
1nF C59
3nF C60
Sec.2 Rear
01
Sec.3 Front
16,2kΩ R44
1kΩ R100
04
05
Conditionin
1kpC mV Unit
11kpC mV/Unit
3 10 30 1 Lin
Upper Freq Limit
03
04
05



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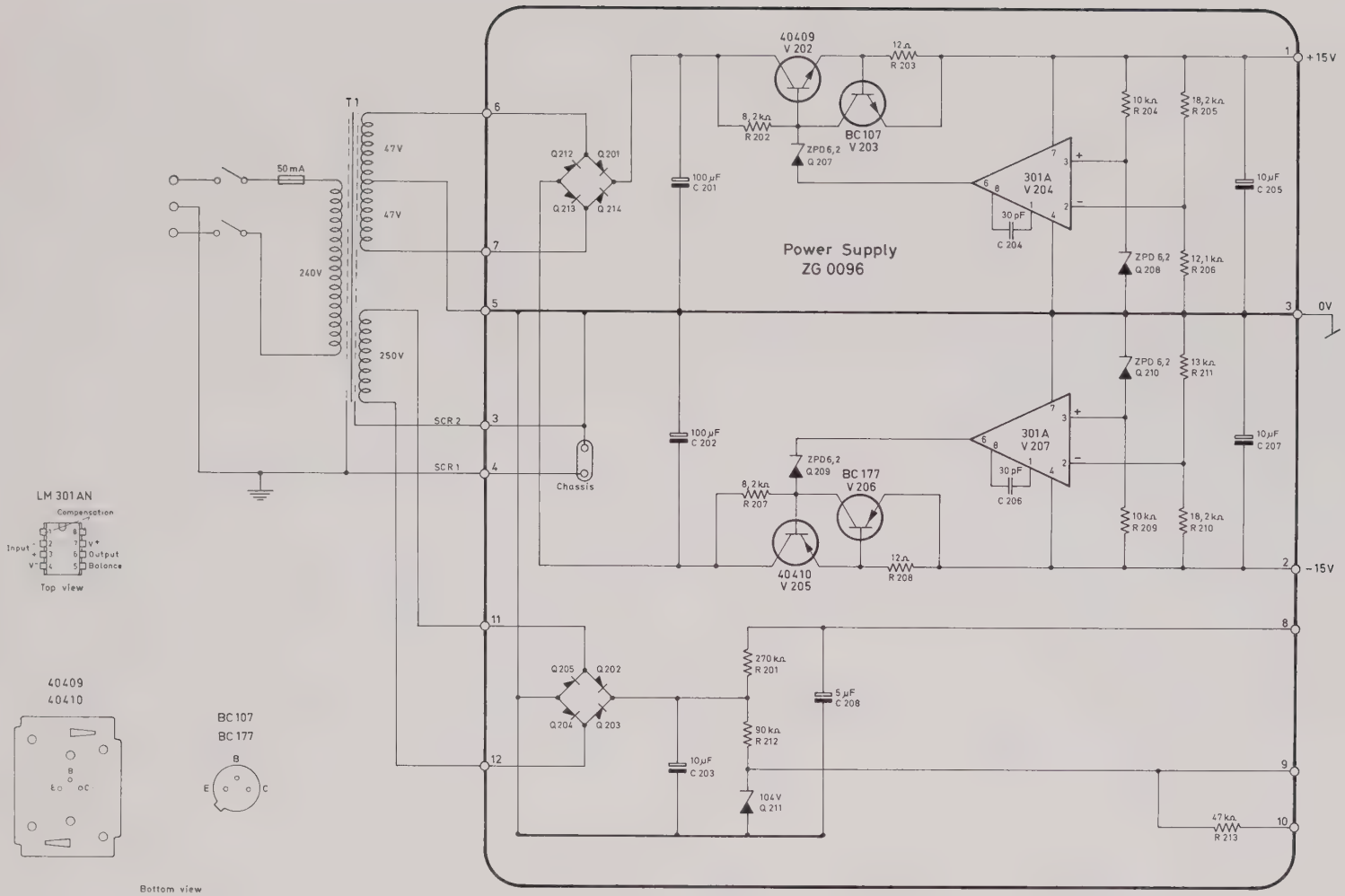
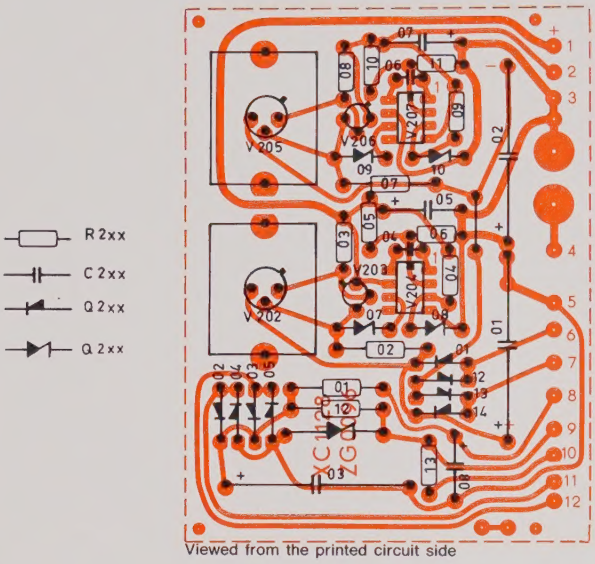

Power Supply
ZG 0096
T1
50 mA
240V
47V
47V
250V
SCR 2
SCR 1
Chassis
Q212
Q201
Q213
Q214
Q205
Q202
Q204
Q203
100 µF
C 201
100 µF
C 202
10µF
C 203
40409
V 202
12 Ω
R 203
8,2 kΩ
R 202
ZPD6,2
Q 207
BC107
V 203
301 A
V 204
30 pF
C 204
10 kΩ
R 204
18,2 kΩ
R 205
10µF
C 205
ZPD 6,2
Q 208
12,1 kΩ
R 206
ZPD 6,2
Q 210
13 kΩ
R 211
301 A
V 207
30 pF
C 206
10µF
C 207
ZPD6,2
Q 209
BC 177
V 206
8,2 kΩ
R 207
40410
V 205
12 Ω
R 208
10 kΩ
R 209
18,2 kΩ
R 210
270 kΩ
R 201
90 kΩ
R 212
5 µF
C 208
10,4 V
Q 211
47 kΩ
R 213
+15V
0V
-15V
LM 301 AN
Compensation
Input
V+
Output
Balance
Top view
40409
40410
BC 107
BC 177
B
E
C
Bottom view



Viewed from the printed circuit side

C 201,202	Electrolytic		100 µF/100 V	CE 0612
C 203	-		10 µF/350 V	CE 0919
C 204	Ceramic		30 pF/400 V	CK 0105
C 205	Electrolytic		10 µF/25 V	CE 0416
C 206	Ceramic		30 pF/400 V	CK 0105
C 207	Electrolytic		10 µF/25 V	CE 0416
C 208	-		5 µF/70 V	CE 0200

Q 201	Si.	1N4004	400 V/1 A	QV 0237
Q 202-205	-	BYX10	1200 V/150 mA	QV 0025
Q 207	Ze.	ZPD6,2	5,9-6,5 V/0,25 W	QV 1334
Q 208	-	ZPD6,2	5,9-6,5 V/0,25 W	QV 1125
Q 209	-	ZPD6,2	5,9-6,5 V/0,25 W	QV 1334
Q 210	-	ZPD6,2	5,9-6,5 V/0,25 W	QV 1125
Q 211	-	ZF104	101-107 V/0,25 W	QV 1323
Q 212-214	Si.	1N4004	400 V/1 A	QV 0237

R 201	Carbon	1/3 W	5%	270 kΩ	
R 202	-	-	-	8,2 kΩ	
R 203	-	1/4 W	-	12 Ω	RB 1120
R 204	-	-	-	10 kΩ	RB 4100
R 205	Metal	-	1%	18,2 kΩ	RF 4182
R 206	-	-	-	12,1 kΩ	RF 4121
R 207	Carbon	1/3 W	5%	8,2 kΩ	
R 208	-	1/4 W	-	12 Ω	RB 1120
R 209	-	-	-	10 kΩ	RB 4100
R 210	Metal	-	1%	18,2 kΩ	RF 4182
R 211	-	-	-	13 kΩ	RF 4130
R 212	Carbon	1/3 W	5%	90 kΩ	
R 213	-	1/4 W	-	47 kΩ	RB 4470

V 202	Silicon	NPN	40409	VB 0509
V 203	-	-	BC107	VB 0032
V 204	Op. Ampl.		LM301AN	VE 0017
V 205	Silicon	PNP	40410	VB 0073
V 206	-	-	BC177	VB 0071
V 207	Op. Ampl.		LM301AN	VE 0017

	Printed Circuit Board	XC 1128

Parts shown on the circuit diagram but not included in ZG 0096.

T 1	Power Transformer	TN 0088
	Fuse 50 mA Slow	VF 0016
	Fuse socket	JS 0019
	On-Off switch (Mains Power)	NN 0014

ZG 0096

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